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AGRICULTURAL EXPERIMENT STATION
MORGANTOWN, W. VA.

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EXPERIMENTS
IN THE
MANURING OF A MEADOW

By J. H. STEWART AND HORACE ATWOOD.

[The Bulletins and Reports of this Station will be mailed free to any citizen of West Virginia upon written application. Address Director of Agricultural Experiment Station, Morgantown, W. Va.]

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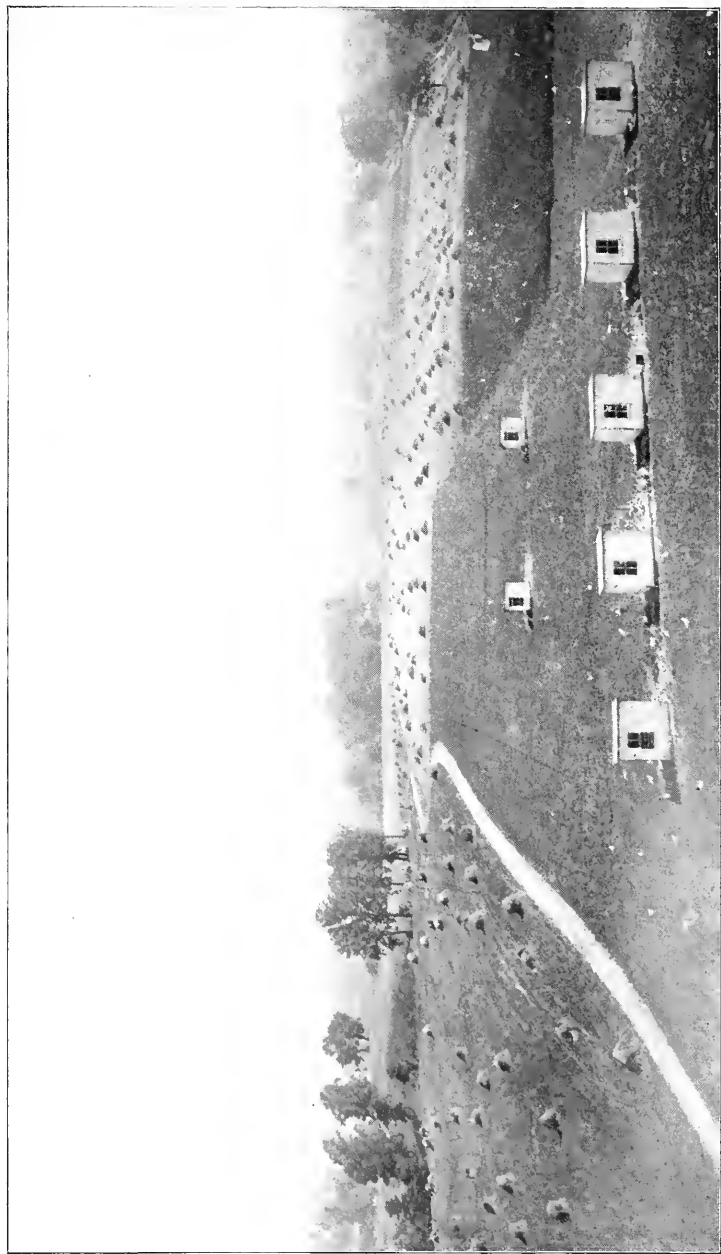
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View of Station Farm, 1904

EXPERIMENTS IN THE MANURING OF A MEADOW.

When meadow land is compared with that which is cultivated an important difference is observed. The land which is covered with a good sod becomes richer from year to year in organic matter or humus, and in combined nitrogen, while in the cultivated soil the exact opposite is usually the case.

When we reflect that the fertility of any soil is largely measured by its ability to furnish a sufficient supply of nitrates and of water to the plant during its period of growth, both of which depend to a large extent upon the presence in the soil of humus, and the nitrogen combined therewith, then only can we realize the fundamental difference as conservers, and in fact, creators of fertility between meadow land and that which is tilled.

In the case of meadows the soil is prevented from washing, and what is more important the plant food is absorbed by the rootlets as fast as it is liberated from the compounds in which it is present in the soil, thus little or none is drained away. On the other hand cultivated land usually grows poorer, both on account of a more rapid oxidation of the humus, and the unavoidable losses of nitrogen, lime, and other plant foods in the drainage waters.

The meadow should be the most profitable portion of the farm, but it is not. It has been neglected. Perhaps not intentionally, but more often because attention has seldom been called to the advisability of manuring it and of giving it the same amount of care that the cultivated land receives.

The experiment reported in this bulletin shows how an unfertile upland meadow was made to produce an average yield for six years of more than three tons of hay per acre, the yields gradually increasing from a little more than one and one-half

tons per acre the first year to a maximum of more than five and one-half tons of hay per acre the last year.

The entire meadow produced hay during the six years of the test, to the value of more than \$36.00 per acre per year in addition to paying for all the fertilizer applied. This annual excess of \$36.00 equals the original value of the land, or in other words, the crop has averaged to pay, not only for all the fertilizers applied, but for the land also each year. Not only that, but the land at the close of the five years is much more valuable, agriculturally, than it was at the beginning of the test.

The field used in this experiment has been used for the production of various crops from the time when this section of the country was first settled, and as no commercial fertilizer, and only a very limited amount of stable manure had been applied to it, the readily available fertility of the soil had been nearly exhausted. Under ordinary management, and without the use of fertilizers, it would produce from one-half to one ton of hay per acre per year for three or four years in succession, then it would be necessary to re-seed it on account of the invasion of running briars and cinque-foil. The field contains four acres and 107 square rods of land. The Experiment Station came into possession of this field in the spring of 1899. The preceding fall it had been sown to wheat and timothy, and in the spring a small amount of clover seed was sown, resulting in a fair stand of grass. (After the first crop the clover practically disappeared.)

FIRST YEAR OF THE TEST.

During the winter of 1899-1900 stable manure was applied to two-thirds of the field at the rate of 25 loads per acre. The manure was obtained from livery stables in Morgantown and was spread on the meadow directly from the wagon. Just before the grass began to grow in the spring, the stable manure plat was thoroughly harrowed with a smoothing harrow so as to break all the lumps and distribute the manure uniformly over the surface of the ground. The remaining third of the field received an application of two hundred pounds of sodium nitrate

per acre, applied with a grain drill in the latter part of April.

The manure cost fifty cents per load at the stables, and about one dollar per load when spread upon the field. The sodium nitrate cost \$45.00 per ton.

As the season was favorable there was a good growth of grass upon both portions of the field. The crop was cut July 9th, and the hay sold in the local market for \$15.00 per ton.

Each year the hay has been weighed when drawn from the field. Nearly every year the hay has been cured in the shock for two or three days, and in all cases it has been cured thoroughly enough when weighed to keep well in the mow.

The following table shows the yield, the value of the hay, the cost of the fertilizer, and the value of the crop per acre less the cost of the fertilizer:

	Yield of hay per acre	Value of hay per acre	Cost of ferti- lizer per acre	Value of crop less the cost of fertilizer per acre.
Stable manure plat	3775 lbs.	\$28.31	\$25.00	\$ 3.31
Commercial fertilizer plat	3232 lbs.	\$24.24	\$ 4.50	\$19.74

If we assume that the yield without fertilizer would have been one-half of a ton per acre it is evident that the use of the sodium nitrate was highly profitable, and that as far as the immediate effect of the stable manure was concerned it was applied at an actual loss.

SECOND YEAR OF THE TEST.

Early in the autumn of 1900 the entire meadow received an application of four hundred pounds per acre of acid phosphate. In the winter the stable manure plat received a further dressing of twelve loads per acre of manure, while early in May the commercial fertilizer plat received a dressing of one hundred and

twenty-five pounds of sodium nitrate, one hundred and twenty-five pounds of acid phosphate, and seventy-two pounds of potassium sulphate per acre.

As there was an abundance of rain in the early part of the summer there was a good growth of grass upon both plats. This was cut July 8th, and the hay sold shortly after for \$15.00 per ton.

The following table gives the yield per acre for each plat, the cost of the fertilizer applied, and other details of the experiment. The cost of the manure is calculated at \$1.00 per load, the acid phosphate at \$13.50 per ton, the sodium nitrate at \$45.00 per ton, and the potassium sulphate at \$50.00 per ton.

	Yield of hay per acre	Value of hay per acre	Cost of fertilizer per acre	Value of crop less cost of fertilizer per acre
Stable manure plat	7219 lbs.	\$54.14	\$14.70	\$39.44
Commercial fertilizer plat	6095 lbs.	\$45.71	\$ 8.15	\$37.56

During the second year of the test the yield of well cured hay for the entire field was more than three tons per acre, and both systems of manuring were highly profitable.

The stable manure plat produced 1124 pounds of hay per acre more than the commercial fertilizer plat, and the value of the crop less the cost of the fertilizer was \$1.88 greater. This favorable result is probably due to the beneficial after-effect of the heavy dressing of stable manure applied during the first year of the test. The average for the two years, however, is in favor of the commercial fertilizer.

THIRD YEAR OF THE TEST.

The stable manure plat received an application of ten loads of manure per acre. It was harrowed thoroughly in March and

then rolled. The fertilizer was applied to the commercial fertilizer plat April 19th, at the rate of 110 pounds of acid phosphate, 80 pounds of sodium nitrate, and 40 pounds of potassium sulphate per acre.

The first crop of hay was cut July 15th, and sold soon after for \$16.00 per ton. The second crop was cut September 19th, and in the following table is valued at \$12.00 per ton.

The results for this year are shown in the following table, the cost of the manure and commercial fertilizer being valued the same as last year :

	Yield of hay per acre Pounds	Value of hay per acre	Cost of ferti- lizer per acre	Value of crop less cost of fer- tilizer per acre
Stable manure plat:				
Crop 1	5163			
Crop 2	2798	\$58.08	\$10.00	\$48.08
Commercial fertilizer plat:				
Crop 1	3996			
Crop 2	1606	\$41.59	\$ 3.49	\$38.10 _a

The stable manure plat produced almost four tons of well cured hay per acre, while the commercial fertilizer plat produced less than three tons, the difference in the yields being 2359 pounds per acre. In 1901, the stable manure plat produced 1124 pounds of hay per acre more than the commercial fertilizer plat and the larger difference in the yields this year was probably due to the extremely dry weather which prevailed in May, the commercial fertilizer plat being more severely injured than the other.

FOURTH YEAR OF THE TEST.

The stable manure plat received a dressing of twenty loads per acre of manure applied in October and November. As in

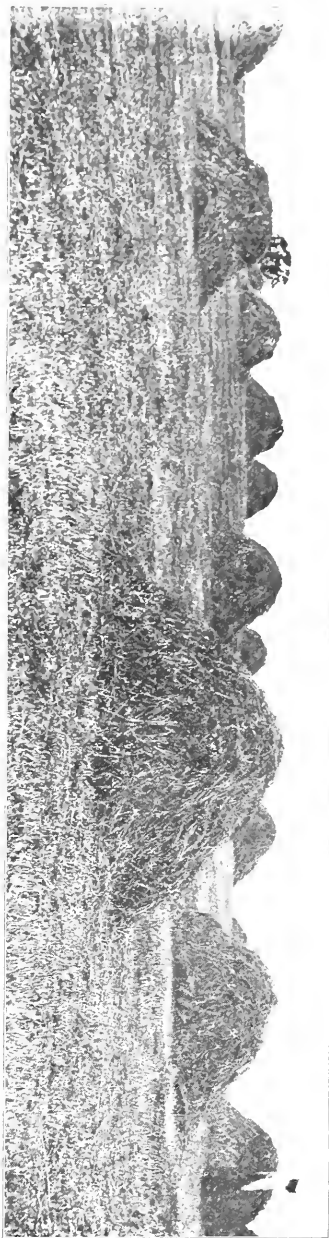
former years this plat was harrowed thoroughly in the spring and rolled. The commercial fertilizer was applied to the other plat at the rate of 400 pounds of sodium nitrate, 800 pounds of acid phosphate, and 150 pounds of potassium sulphate per acre. This was applied as a top-dressing April 20th.

The spring and summer of 1903 were not particularly favorable for a heavy growth of grass. A warm March which caused the grass to start vigorously was followed by a cold April. The severe freeze on the 5th of that month was succeeded by a period of dry weather which continued till the latter part of May. The precipitation during the latter part of May and June, however, was abundant and a fair growth resulted, notwithstanding the unfavorable beginning. The first crop was cut July 13th, and the second September 21st. On account of the dry weather which prevailed during August and September, the second crop was small.

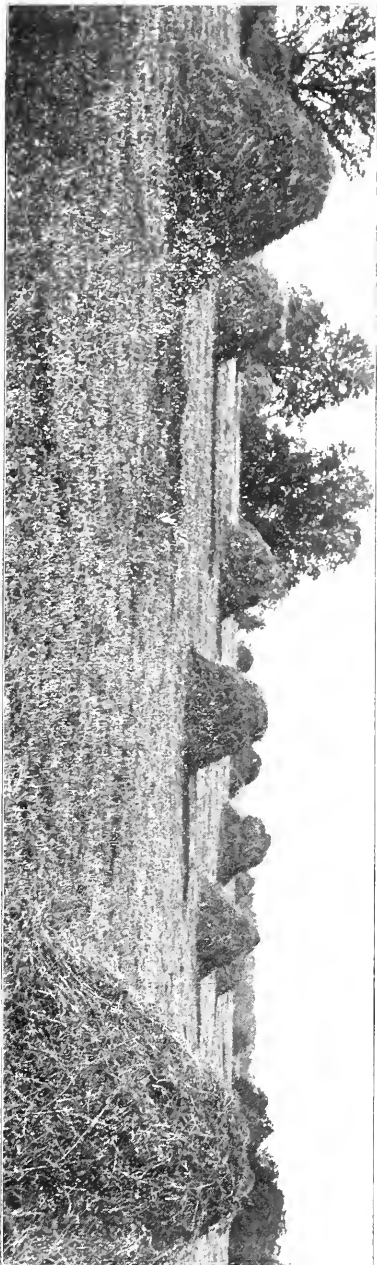
The following table shows the yield and value of the hay per acre for the two plats, the cost of fertilizer, and the value of the crop less the cost of the fertilizer. In this table the hay and fertilizers have been valued the same as they were last year:

		Yield of hay per acre Pounds	Value of hay per acre	Cost of ferti- lizer per acre	Value of crop less cost of fer- tilizer per acre
Stable manure plat:					
	Crop 1	5548			
	Crop 2	1863	\$55.56	\$20.00	\$35.56
Commercial fertilizer plat:					
	Crop 1	6573			
	Crop 2	739	\$57.01	\$18.15	\$38.86

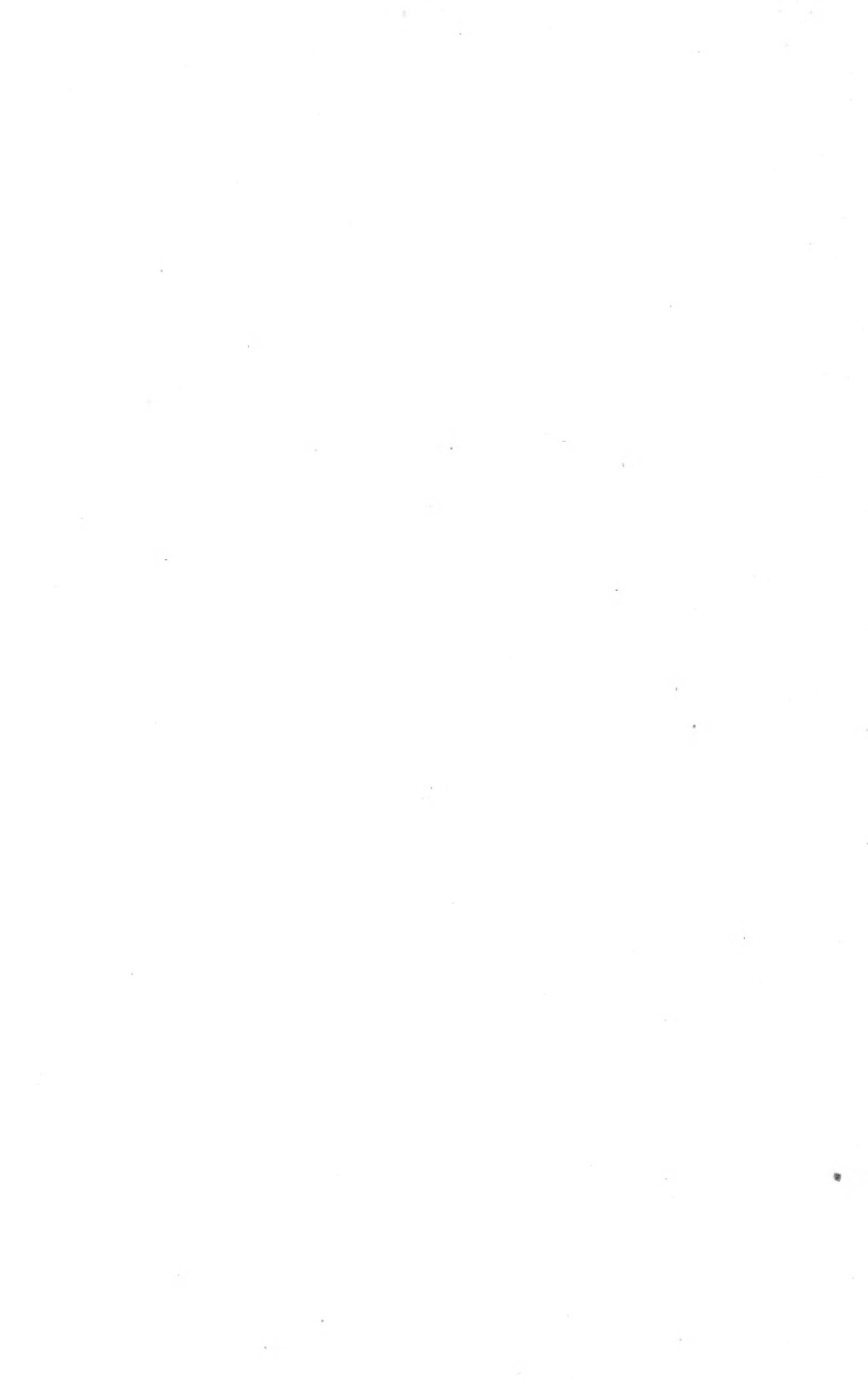
The stable manure plat yielded at the rate of 7411 pound of hay per acre, and the commercial fertilizer plat at the rate of 7312 pounds per acre, the heavier application of commercial fertilizer



The "First Crop" of Timothy. Photographed July 18, 1905. Yield 8,527 pounds per acre.



The "Second Crop" of Timothy. Photographed October 10, 1905. Yield 2,788 pounds per acre.



having brought the total yield nearly up to that of the stable manure plat. On account of the smaller cost of the fertilizer and the larger first crop the value of the crop less the cost of the fertilizer was somewhat more in the case of the commercial fertilizer plat.

FIFTH YEAR OF THE TEST.

Both plats received the same kind and amount of fertilizer as in the preceding year. The commercial fertilizer was applied April 11th, and the stable manure during the fall and winter of 1903-04.

As in previous years the stable manure plat was thoroughly harrowed in the spring. Both plats were rolled April 13th.

As the season was favorable a heavy growth of grass resulted on both plats. This was cut July 13th. The following weather was very dry, but there was some growth on the stable manure plat. This was cut and made into hay October 5th.

The following table shows the yield and value of the hay per acre for the two plats, the cost of the fertilizer, and the value of the crop less the cost of the fertilizer. In this table the fertilizer is valued the same as in previous years, and the hay, first crop, at \$15.00 per ton, and the second crop at \$12.00.

		Yield of hay per acre Pounds	Value of hay per acre	Cost of ferti- lizer per acre	Value of crop less cost of fer- tilizer per acre
Stable manure plat:					
	Crop 1	8845			
	Crop 2	1743	\$76.79	\$20.00	\$56.79
Commercial Fertilizer plat:					
	Crop 1	8088	\$60.66	\$18.15	\$42 51

The table shows that the stable manure plat produced more than five tons of hay per acre, while the commercial fertilizer plat produced more than four tons.

SIXTH YEAR OF THE TEST.

The stable manure plat received a dressing of fifteen loads of manure per acre applied in the autumn of 1904. As in previous years this plat was thoroughly harrowed in the spring. The commercial fertilizer plat was fertilized the same as the year before, namely, at the rate of 400 pounds of sodium nitrate, 800 pounds of acid phosphate, and 150 pounds of potassium sulphate per acre. This mixture was applied with a grain drill, April 11, 1905.

Both plats were cut for hay July 17th. The hay was tedded and placed in shock where it remained until it was thoroughly dry. It was weighed when drawn from the field. The second crop was cut October 7th. It was allowed to lie in the swath until the 9th. It was then raked and shocked. The next day it was drawn from the field and weighed.

The following table shows the yields of hay and the financial results, the hay and fertilizer being valued at the same rate as last year.

		Yield of hay per acre Pounds	Value of hay per acre	Cost of ferti- lizer per acre	Value of crop less cost of fer- tilizer per acre
Stable manure plat:					
	Crop 1	8527			
	Crop 2	2788	\$80.68	\$15.00	\$65.68
Commercial fertilizer plat;					
	Crop 1	7621			
	Crop 2	334	\$59.16	\$18.15	\$41.01

The table shows that the stable manure plat produced more than five and one-half tons of hay per acre, while the commercial fertilizer plat produced slightly less than four tons per acre. The most striking difference was in the yields of the second crop. Owing to the abundant rainfall following the first cutting there was a heavy growth of short but thick grass upon the stable

manure plat while upon the commercial fertilizer plat there was practically no growth. This indicates that the first crop on the commercial fertilizer plat used practically all of the readily available fertility leaving little or none for the second crop, while in the case of the stable manure plat enough plant food was available so that a large second crop resulted.

The following table summarizes the results for the six years of the test :

Year	Yield of hay per acre in pounds		Value of hay per acre		Cost of ferti- lizer per acre		Value of crop less cost of the fertilizer per acre	
	Stable Manure	Com. Fert.	Stable Manure	Com. Fert.	Stable Manure	Com. Fert.	Stable Manure	Com. Fert.
1900	3775	3232	\$28.31	\$24.24	\$25.00	\$ 4.50	\$ 3.31	\$19.74
1901	7219	6095	54.14	45.71	14.70	8.15	39.44	37.56
1902	7961	5602	58.08	41.59	10.00	3.49	48.08	38.10
1903	7411	7312	55.56	57.01	20.00	18.15	35.56	38.86
1904	10588	8088	76.79	60.66	20.00	18.15	56.79	42.51
1905	11315	7955	80.68	59.16	15.00	18.15	65.68	41.01
Average.	8044	6380	58.92	48.06	17.45	11.76	41.47	36.29

Several things of interest and also of practical importance are shown by this table. In the first place neither the stable manure nor the commercial fertilizer seems to be "injuring the land" as the yield has increased from less than two tons per year during the first year, to a maximum of more than five and one-half tons during the last year. The stable manure plat gave an average yield of 1664 pounds of hay per acre more than the commercial fertilizer plat, yet on account of the extra cost of the manure as compared with the commercial fertilizer, the value of the crop, less the cost of the fertilizer, was only \$5.18 larger per year. However, under ordinary farm conditions the cost of a two-horse load of manure spread upon the land is far less than one dollar per load so in reality the difference in profit is considerably larger

than is shown by the table. In addition to this difference the stable manure plat is in a far better condition agriculturally at the end of the sixth year than the commercial fertilizer plat. The soil of the former is full of decomposing vegetable matter, and is soft and yielding to the tread, while the soil of the commercial fertilizer plat is hard and compact. The open and porous soil of the stable manure plat enables this soil to store up more moisture so that a crop growing thereon would be less likely to be injured by drought than is the case in the other instance.

CONCLUSIONS.

1. Both systems of manuring were highly profitable.
2. Large crops of grass can be grown upon soils of this class provided that sufficient plant food is supplied for the needs of the crop.
3. Stable manure when applied to meadow land in the fall and thoroughly harrowed in the spring becomes so disintegrated and incorporated with the surface of the soil that it is not raked up with the hay when the hay is harvested.
4. The use of stable manure, even when valued at one dollar per load when spread upon the meadow, was more profitable than the use of commercial fertilizer.
5. The annually-repeated top-dressings of stable manure has left the soil in better condition agriculturally than the dressings of commercial fertilizer.

